



U.S. Department  
of Transportation  
**Federal Highway  
Administration**

**MAY -9 2001**

400 Seventh St., S.W.  
Washington, D.C. 20590

Refer to: HSA-1/WZ-69

Ms. Kathy Rogalla  
Project Leader  
Marketing Displays International  
38271 W. Twelve Mile Rd  
Farmington Hills, MI 48331-3041

Dear Ms. Rogalla:

Thank you for your letters of December 5, 2000, and January 24, requesting Federal Highway Administration (FHWA) acceptance of your company's portable sign stands as crashworthy traffic control devices for use in work zones on the National Highway System (NHS). Accompanying your letters were detailed drawings of the stands, reports from Safety Quest, Inc., and videos of the crash tests. You requested that we find your company's temporary sign stands acceptable for use on the NHS under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features." A March 12 letter from Dr. Dean Alberson of Safety Quest attested to the performance of these sign stands when used with plywood sign panels.

#### **Introduction**

The FHWA guidance on crash testing of work zone traffic control devices is contained in two memoranda. The first, dated July 25, 1997, titled "INFORMATION: Identifying Acceptable Highway Safety Features," established four categories of work zone devices: Category I devices were those lightweight devices which could be self-certified by the vendor, Category II devices were other lightweight devices which needed individual crash testing, Category III devices were barriers and other fixed or massive devices also needing crash testing, and Category IV devices were trailer mounted lighted signs, arrow panels, etc. The second guidance memorandum was issued on August 28, 1998, and is titled "INFORMATION: Crash Tested Work Zone Traffic Control Devices." This later memorandum lists devices that are acceptable under Categories I, II, and III.

A brief description of the devices for which you are requesting acceptance follows:

#### **Model 4860K, tested with Endurance panel and Aluminum panel:**

[Tests MDI 3 and MDI 4]

This stand is manufactured with two vertically mounted steel coil springs to support 1219 x 1219 x 2 mm ( 48 x 48 x 0.080 inch) signs. The base of the sign stand consists of an autophoretic coated 5 mm thick steel base, four telescoping legs, and two coil springs. The legs are 3 mm x 32 mm x 32 mm (0.10 x 1.25 x 1.25 inch) 6061-T6 aluminum tubing. A 3 mm x 38 mm x 38 mm (0.10 x 1.5 x 1.5 inch) extruded aluminum lower mast is mounted to the top of the springs. The

lower mast is attached to the springs with two 10 mm x 64 mm (0.375 - 18 x 2.5 inch) bolts through an L-bracket. The lower mast is scored at the top of the L-bracket around its circumference and the corners are cut as to not penetrate all the way through the material. In addition, a 10 mm (0.375 inch) hole is drilled through the lower mast approximately 38 mm (1.5 inch) up from the top of the L-bracket through the axis parallel to the sign blank. A 3 mm x 32 mm x 32 mm (0.1 x 1.25 x 1.25 inch) 6061-T6 aluminum upright is mounted to the lower mast and held into place with push-button spring pins. The sign panel is attached to the upper and lower masts with a rigid steel mounting bracket that is clamped to the masts. Attached to the top of the upper mast is a steel flag lock bracket that holds three wood handled vinyl roll-up flags.

The overall height of the MDI 4860K sign stand with vinyl flags mounted above is 4013 mm (158 inches) and 3252 mm (128 inches without flags). The bottom of the sign is mounted 1524 mm (60 inches) above grade. The total weight of the sign stand with a 4.8 kg (10.5 pound) Endurance sign panel and flags is 26.3 kg (58 pounds) as tested in MDI 3. The total weight with a 2 mm (0.080 inch) 8.4 kg (18.5 pound) aluminum sign panel is 29.9 kg (66 pounds) as tested in MDI 4.

**Model 4860K, with breakaway feature, tested with Aluminum panel and light:**

[Test MDI 6]

This stand is manufactured with two vertically mounted steel coil springs to support 1219 x 1219 x 2 mm (48 x 48 x 0.080 inch) aluminum signs. The four legs of the stand are 32 x 32 x 2.5 mm (1.25 x 1.25 x 0.10 inch) square 6061-T6 extruded aluminum tubing. The coil springs attach the 5 mm (0.19 inch) thick autophoretic coated steel base to the telescoping upright. The two piece, upright, consisting of a 38 mm (1.50 inch)(bottom) and a 32 mm (1.25 inch)(top) square aluminum tube, supports the sign. The bottom upright has a scored "breakaway section" at 483 mm (19 inches) above grade when the stand is fully assembled. Rigid sign mounting brackets support the aluminum sign at top and bottom and a steel flag lock bracket is attached to the top upright supporting three hardwood dowel flags. A barricade light assembly, consisting of two 6 volt batteries and a 178 mm (7 inch) polycarbonate lens, is mounted to the top upright above the flag bracket.

The overall height of the stand, with flags and light is 4115 mm (162 inches) and 3251 mm (128 inches) without the light and flags. The bottom of the sign is mounted 1524 mm (60 inches) above grade. The total weight of the sign stand is 31.6 kg (69.7 pounds) which includes the stand of 21.7 kg (47.7 pounds), the sign and flags of 8.4 kg (18.5 pounds) and the light of 1.6 kg (3.5 pounds) as tested in MDI 4.

**Model 4818 sign stand with breakaway feature, tested with aluminum sign panel and flags**

[Test MDI 8]

The MDI model 4818 is a portable, compact sign stand that is manufactured with two vertically mounted steel coil springs to support 1219 x 1219 x 2 mm (48 x 48 x 0.080 inch) aluminum signs. The four legs of the stand are 32 x 32 x 2.5 mm (1.25 x 1.25 x 0.10 inch) square 6061-T6 extruded aluminum tubing. The coil springs attach the 5 mm (0.19 inch) thick autophoretic coated steel base to the telescoping upright. The two piece, upright, consisting of a 38 mm (1.50 inch)(bottom) and a 32 mm (1.25 inch)(top) square aluminum tube, supports the sign. The bottom upright has a scored "breakaway section" at 457 mm (18 inches) above grade when the stand is fully assembled. Rigid sign mounting brackets support the aluminum sign at top and bottom and a polycarbonate flag lock bracket is attached to the top upright, supporting three hardwood dowel flags.

The overall height of the stand, with flags is 3023 mm (119 inches) and 2184 mm (86 inches) without the light and flags. The bottom of the sign is mounted 457 mm (18 inches) above grade. The total weight of the sign stand is 21.5 kg (47.4 pounds) which includes the stand of 12.8 kg (28.2 pounds), the sign and flags of 8.7 kg (19.2 pounds).

You also requested that we accept the following signs with the 4860K and the 4818 stands:

Size	Material	Weight	Thickness
915 mm (36"x36")	Aluminum	5.2 kg (11.5#)	2 mm (0.080")
1220 mm (48"x48")	Plywood	15.9 kg (35#)	16 mm (5/8")
915 mm (36"x36")	Plywood	15.9 kg (35#)	16 mm (5/8")
1220 mm (48"x48")	Endurance	4.8 kg (10.5#)	16 mm (5/8")
915 mm (36"x36")	Endurance	3.0 kg (6.5#)	16 mm (5/8")
1220 mm (48"x48")	Alpolic	4.8 kg (10.5#)	2.5 mm (0.10")
915 mm (36"x36")	Alpolic	3.0 kg (6.5#)	2.5 mm (0.10")
<b>Tested Sign:</b>			
1220 mm (48"x48")	Aluminum	5.2 kg (11.5#)	2 mm (0.080")

You also requested the use of plywood signs but their weight, approximately twice that of the tested aluminum signs, caused us to ask for further analysis. The March 12 letter from Dr. Alberson predicts acceptable performance of this stand with plywood, stating that the increased sign inertia could assist in the activation of the breakaway mechanism and would serve to slow the angular rotation of the sign panel. There would be no greater likelihood that the sign would impact the test vehicle. Indeed, the increased sign inertia would allow the vehicle to pass under the rotating sign with additional clearance.

You also requested acceptance of your **Model 5018**, which is similar to the Model 50SM and Model 4818 with the "Break Away" feature added to the aluminum upright tested (see table below). It has steel legs and base (from the 50SM) and an aluminum upright with the breakaway feature as tested with the Model 4818.

### Testing

Full-scale automobile testing was conducted on your company's devices. Two stand-alone examples of each device were tested in tandem, one head-on and the next placed six meters downstream turned at 90 degrees, as called for in our guidance memoranda. The complete devices as tested are shown in the Enclosure 1.

The crash tests are summarized in the table below:

Test Number	MDI 3	MDI 4	MDI 6	MDI 8
Test Article	4860K	4860K	4860K Breakaway	4818 Breakaway
Sign substrate	Endurance	Aluminum	Aluminum	Aluminum
Height to Bottom of Sign	1524 mm	1524 mm	1524 mm	457 mm
Height to Top of Sign	3252 mm	3252 mm	3251 mm	2184 mm
Flags or lights	3 flags	3 flags	2 flags, light	3 flags
Test Article Mass (each)	26.3 kg	29.9 kg	31.6 kg	21.5 kg
Vehicle Inertial Mass	802 kg	802 kg	822 kg	822 kg
Impact Speed, Head-on	101.7 kph	100.9 kph	98 kph	101 kph
Vehicle damage	Punctured oil pan & radiator	Punctured oil pan & radiator	Scrapes and Dents	Scrapes and Dents
Occupant Compartment Intrusion	None	None	None	None
Windshield Damage	37.75 mm deformation*	None	None	Moderate**

\* Both layers of glass were broken but the plastic laminate was not punctured. The area of deformation was approximately one foot in diameter, with a maximum deformation towards the occupants of 31.75 mm (1.25 inches.)

\*\* There was localized cracking from the end-on hit near the bottom of the passenger side windshield, and generalized cracking from the head-on impact, but there was no significant deformation, nor was cracking extensive enough to block the driver's view ahead.

### Findings

Damage was limited to cracking of the windshield when the signs struck the glass, and to the undercarriage of the test vehicles. None of the damage modes appeared to have the potential for penetrating the passenger compartment. The results of test met the FHWA requirements and, therefore, the Model 4860K and Model 4818 stands, both with the breakaway feature, described above and shown in the enclosed drawings for reference are acceptable for use as Test Level 3 devices on the NHS under the range of conditions tested, when proposed by a State.

- Because of the successful performance of these stands with Endurance (4860K) and aluminum (4860K and 4818) substrates we consider them to be acceptable with 2.5 mm Alpolyc substrate signs as well. Similarly, we consider the 4818 to be acceptable with the Endurance substrate as well.
- Because of the successful performance with the 48x48 sign panels, we will also consider them acceptable with the smaller 36x36 panels. However, the 4860K stand should support the 36x36 panel at the same height to the top as the tested 48x48 sign. This would

result in a **mounting height of 1955 mm (77 inches) to the bottom**. Tall sign stands, such as the 4860K perform in an acceptable manner in part due to the sign and mast striking the roof line of the test vehicle. If you use a 36x36 sign panel at the "regular" mounting height you lower the top of the entire assembly by 430 mm (17 inches) which may significantly alter the performance.

- Because of the acceptable performance of the 4818 stand, and because of its similarity to the previously accepted Model 50SM (tested by Texas at TTI, letter WZ-3), we will also consider the 5018 stand acceptable with the breakaway feature when used with the sign materials and sizes discussed above.
- Because of the acceptable performance of the breakaway feature, and the likelihood that the increased inertia of a plywood sign would enhance the breakaway performance of the system, the 4860K Breakaway and the 4818 Breakaway sign stands will be acceptable when used with 16 mm plywood signs.

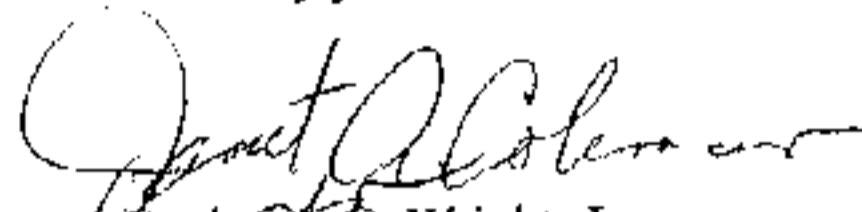
### Summary

Please note the following standard provisions which apply to FHWA letters of acceptance:

- Our acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that they will meet the crashworthiness requirements of FHWA and NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number WZ-69, shall not be reproduced except in full. This letter, and the test documentation upon which this letter is based, is public information. All such letters and documentation may be reviewed at our office upon request.
- MDI portable sign stands may include patented components and if so are considered "proprietary." The use of proprietary work zone traffic control devices in Federal-aid projects is generally of a temporary nature. They are selected by the contractor for use as needed and removed upon completion of the project. Under such conditions they can be presumed to meet requirement "a" given below for the use of proprietary products on Federal-aid projects. On the other hand, if proprietary devices are specified for use on Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must

certify that they are essential for synchronization with existing highway facilities or that no equally suitable alternative exists or, (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411, a copy of which is enclosed.

Sincerely yours,



Frederick G. Wright, Jr.  
Program Manager, Safety

2 Enclosures